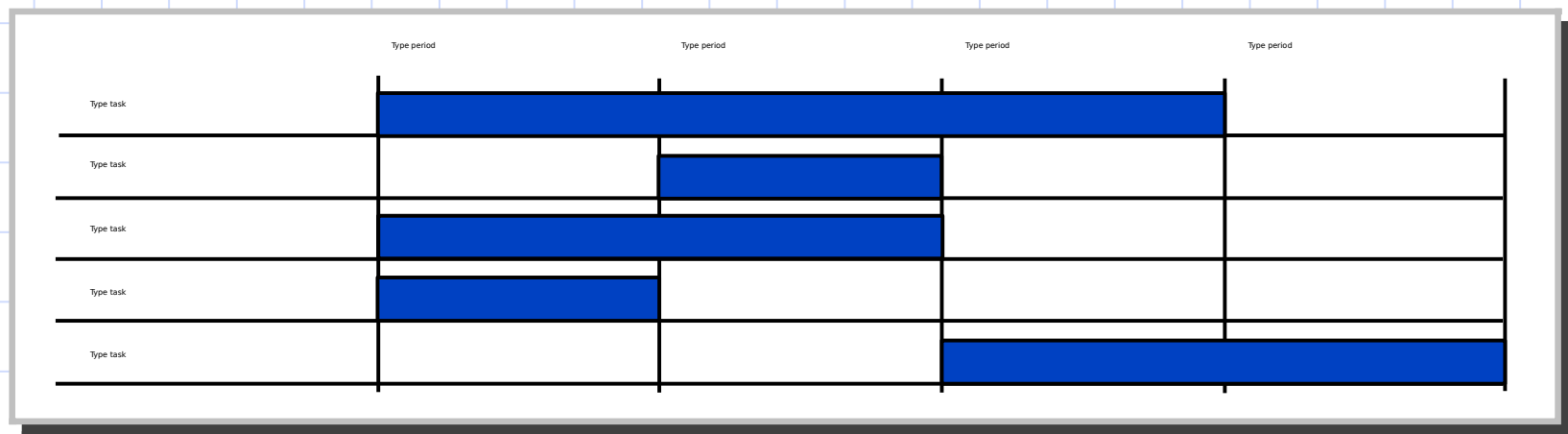
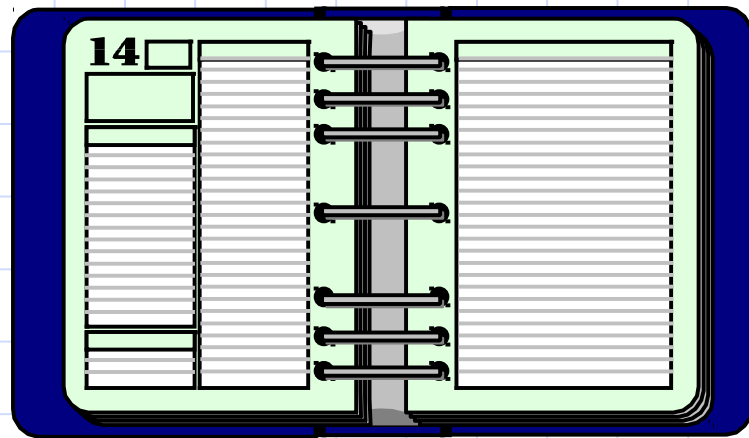
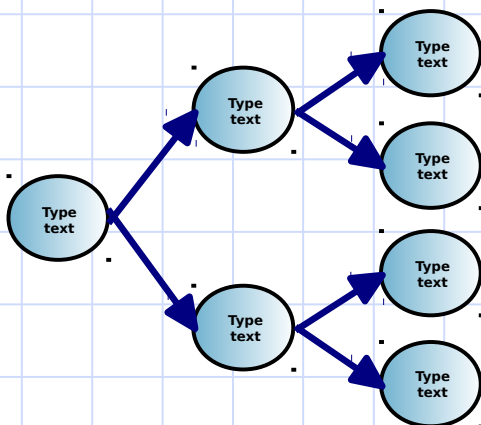


Project Planning & Scheduling



PROJECT PLANNING AND SCHEDULING

The purpose of this lesson is to provide you with the knowledge to plan and supervise activities for construction projects.



CRITICAL PATH METHOD (CPM)

- ➔ CPM is a form of analysis that is used for planning, scheduling, and controlling construction activities for a project from start to finish.
- The CPM requires a formal, detailed listing of all work related activities that make up the project.
- Also referred to as:
 - Construction Management
 - Project Planning and Scheduling
 - Critical Path Analysis

PRELIMINARY PLANNING

- ➔ Preliminary planning is a quick overall picture of the project and the capacity of the unit to accomplish it.
- ▢ Serves as a guide for detailed planning.
- ▢ Includes site recon, preliminary material and equipment estimates, and procurement of critical items.

DETAILED PLANNING

- ➔ Develops an accurate estimation of work activities, materials, man-hours, and equipment requirements needed from start to finish.
- Detailed planning includes:
 - Reviewing project specifications and drawings
 - Detailed estimates of resources.
 - Scheduling work activities.
 - Submitted in the form of a Gantt chart, Pert chart, Activity-on-the-Arrow logic diagram, or Activity-on-the-Node logic diagram.

Job Directive Format

- ➔ The job directive is the tasking of a unit to perform construction tasks, and draw needed materials to complete the project assigned.
- Job directives vary in form and content. They are issued in one of two ways:
 - **Verbally** for simple projects.
 - **Written** for more complex projects.

Stages of Detail

□ Job directives can be in any one of three stages of detail:

- **Contain detailed plans and specifications. The more stable the conditions are, the more detailed the job directive becomes.**
- **May simply refer to standardized drawings, or automated software programs already published.**
- **May require preparation of complete plans and project specifications to be approved by higher headquarters.**

Job Directive Information

- ▮ **Mission:** Exact assignment with all necessary details.
- ▮ **Location:** May be given, or left to the unit to select.
- ▮ **Time:** Starting time and/or required completion date.
- ▮ **Manpower:** Additional manpower that is available.

Job Directive Information

- ▢ **Materials:** Source of and authority to request materials.
- ▢ **Priorities:** Single priority for the whole project, or separate priorities for various portions of the project.
- ▢ **Reports:** Any required reports. (i.e. Weekly status report)
- ▢ **Special Instructions:** Any additional information pertaining to the job that is requested.

ACTIVITY LISTS (Brainstorming)

- ▶ An activities (task) list is a complete listing of all required work activities that must be performed from start to finish.
- ▶ An activity list can be brief, or as detailed as need be. The guiding factor to how much detail that is required is dictated by size and complexity of the project.
- An activity list must be developed **mentally** and on **paper** to determine actual activities and their interrelationships to each other.
- The most difficult step is your ability to think **logically**, and make a mental picture of the project in your mind.

ROUGH ACTIVITIES LISTING

Activities

**“Topo” project site Establish road grades
Lay gravel Set road alignments
Order gravel Place concrete forms
Clear roadway Clear pad site
Prefabricate forms Create project drawings
Layout pad batterboards Excavate pad footings
Pour concrete Cure concrete
Check pad elevations Check Road grades
Remove forms Perform “As-built”**

Sequencing Activities

- After you have developed your rough activity list in no specific order, you must now put the activities into a "logical" sequence to be performed. The finished activity list is broken down as follows:
 - Activity Number Column
 - Activity Column
 - "Immediately Proceeded By" (IPB) Column

Types of Activities

□ There are five types of activities associated with the development of an finished activities list. Keeping these activities in mind will help you in your logical thinking to develop the activity list on paper.

- Starting activities.
- Preceding activities.
- Concurring activities.
- Succeeding activities.
- Lagging activities.

Sample Finished Activities List



Activity

Number

Activity

IPB

5	"Topo" project site	None
10	Create project drawings	5
15	Order gravel	None
20	Prefabricate forms	None
25	Clear roadway	10
30	Set road alignments	25
35	Establish road grades	30
40	Check road grades	35
45	Lay gravel	15,40
50	Clear pad site	10
55	Layout pad batterboards	50
60	Excavate pad footings	55
65	Check pad elevations	60
70	Place concrete forms	20,65
75	Pour concrete	70
80	Cure concrete	75
85	Remove forms	80
90	Perform "as-built"	45,85

PLANNING DIAGRAMS

- The most important part of the CPM is the planning diagram. The planning diagram graphically shows the interrelationship between project activities.
 - It provides a visual blueprint of the work activities that must be performed during construction.
 - There are four types of diagrams that can be created.

GANTT CHART

- ▮ Also known as a bar chart.
- ▮ Gantt charts are "time" oriented.
- ▮ Activities are graphically shown on a calendar time scale, used primarily for small projects.
- ▮ Bars show an activities duration in its entirety, regardless of its dependency on other activities.
- ▮ Effortless to construct, and are brief in format.

[illegible]

[illegible]

GANTT CHART DISADVANTAGE

- ➔ **Does not give you the ability to visualize the exact progress of the project.**
- ▮ **Anticipate delays or problems soon enough to correct them.**
- ▮ **Does not show detailed sequence of activities.**
- ▮ **Does not show "critical activities".**
- ▮ **Does not show precise effect of a delay or failure to complete an activity on time.**

PERT CHART DIAGRAM

- ➔ The Program Evaluation and Review Technique (PERT) addresses probability, and is "event" oriented.
- This type of logic diagram is used primarily for research and development projects.



¶\ð\ðΔ	¶\J0\ðΔ
J	Σq
Jðbðbrolęcsifę	

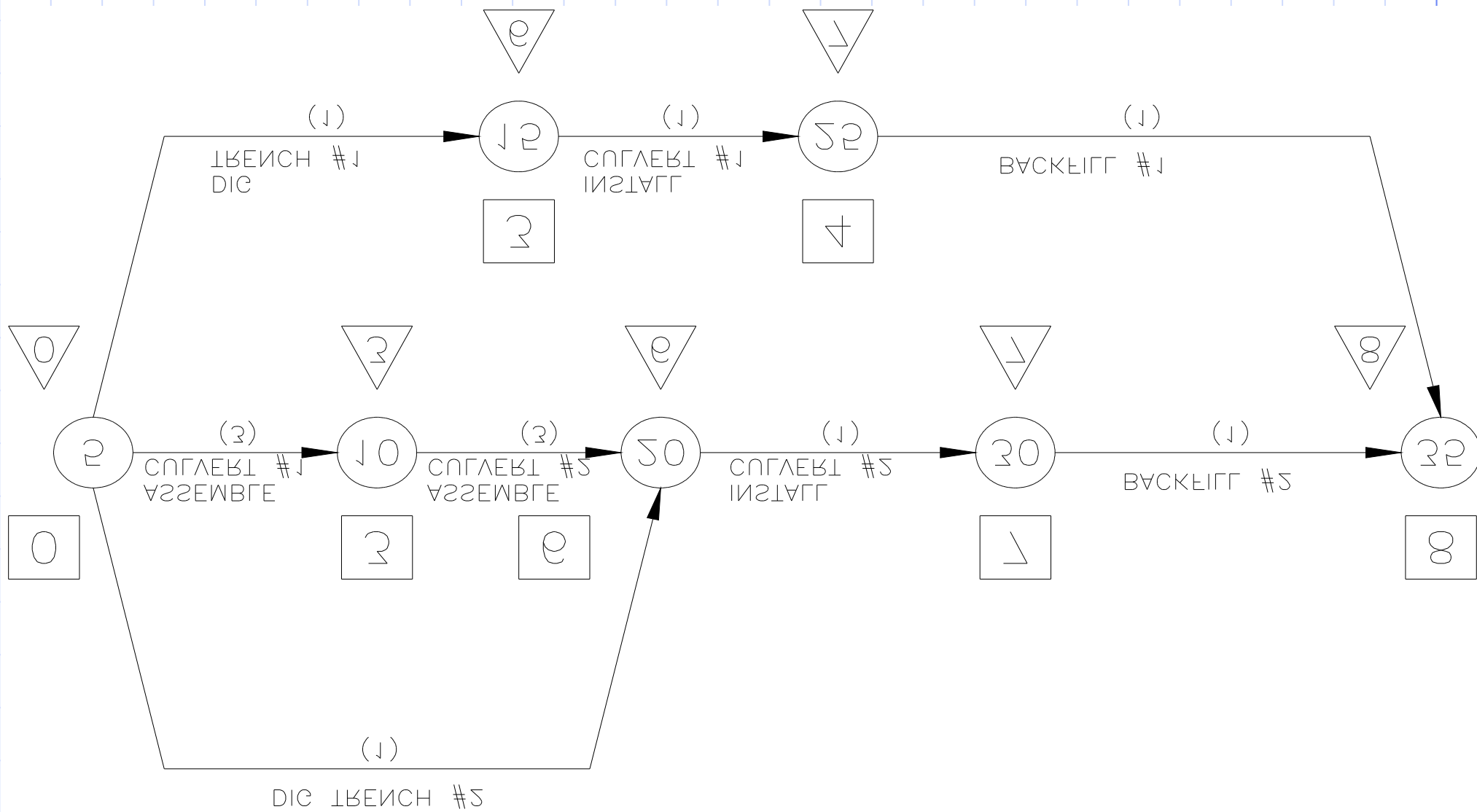
¶\JJ\ðΔ	¶\J¶\ðΔ
Σ	Σq
Cřęąfębrolęcqřęwřędę	

¶\J2\ðΔ	¶\J2\ðΔ
J0	Jq
Cřęąřęqęřę	

¶\J2\ðΔ	¶\Ję\ðΔ
2	Σq
Cřęąřęqęwřęλ	

Activity-On-The-Arrow Format

- ▮ More complex in its creation.
- ▮ Tendency to lead to confusion when trying to interpret it.
- ▮ Least desirable format to use because of these factors.



Activity-On-The-Node Format

- Eliminates confusion, and allows you to adjust for problems that may arise during the construction of the project.
- AON format is "activity" oriented.
- This is the primary format used for planning military construction, and especially used for large projects.

Activity-On-The-Node Uses

- ▮ Construction planning.
- ▮ Maintenance planning.
- ▮ Project Design.
- ▮ Military combat task planning.
- ▮ Logistics planning.

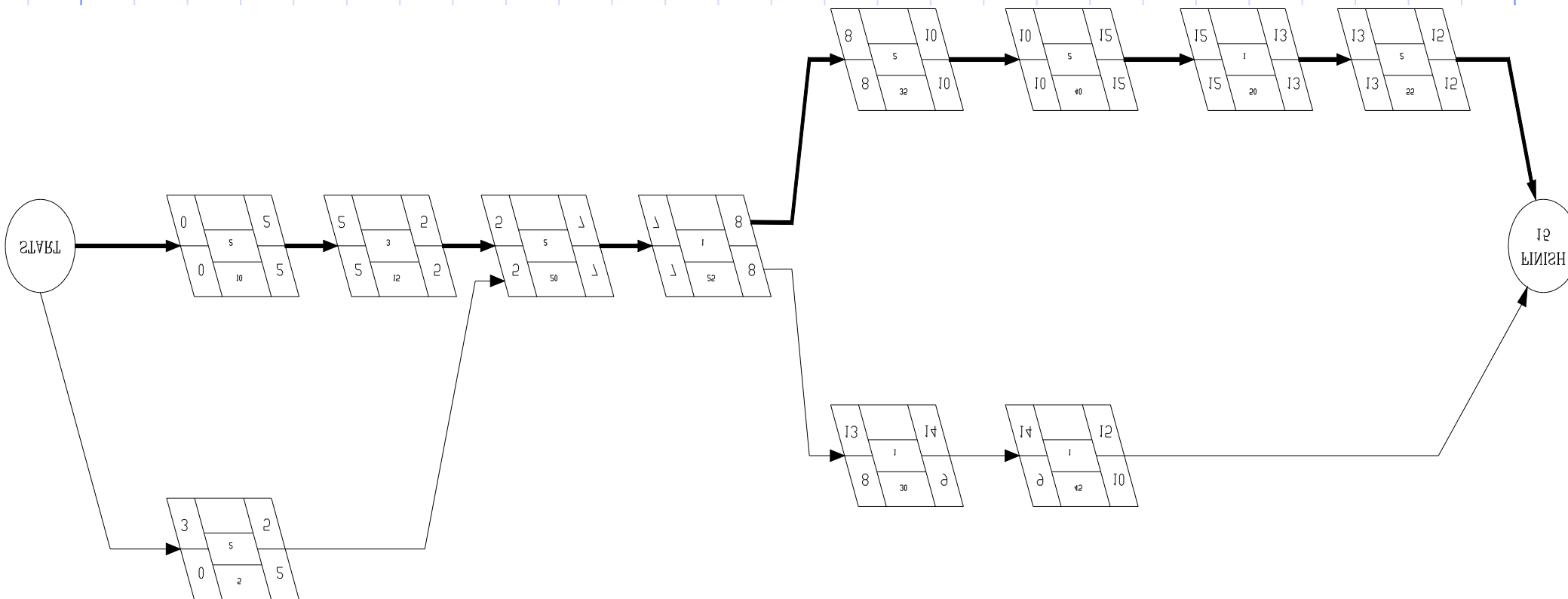
AON Advantages



- ➔ **Reduces risk of overlooking essential tasks.**
- ▮ **Provides a blueprint for long-range planning.**
- ▮ **Shows activity interrelationships.**
- ▮ **Focuses attention on critical activities.**
- ▮ **Allows you to make timely decisions.**
- ▮ **Allows you to manage manpower, material, and equipment resources more effectively.**

AON Disadvantages

- The AON format does not solve engineering problems that may occur.
- Does not make planning decisions for you.
- Does not provide anything substantial to the actual construction of the project itself.

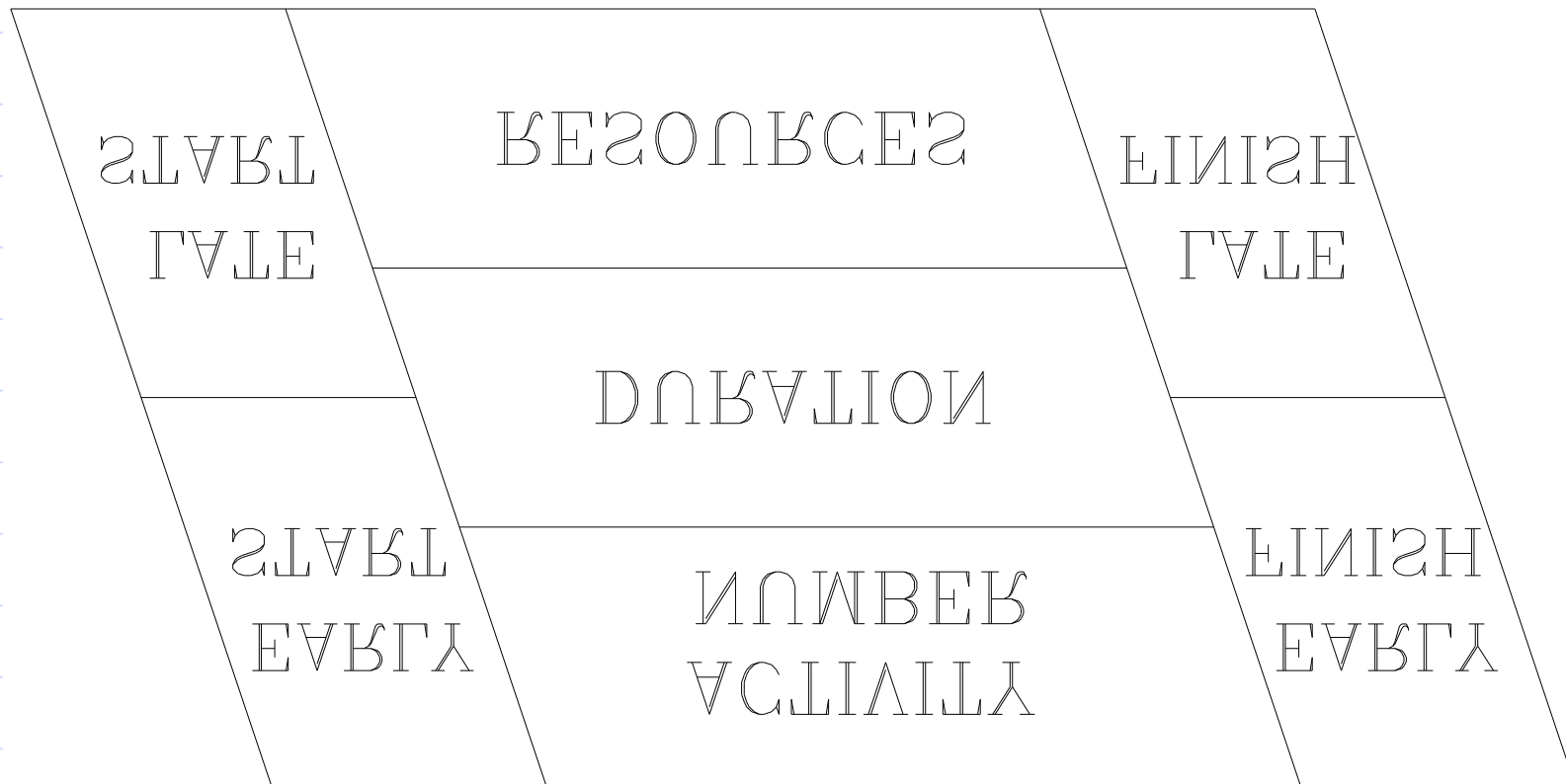


LOGIC DIAGRAMS ELEMENTS

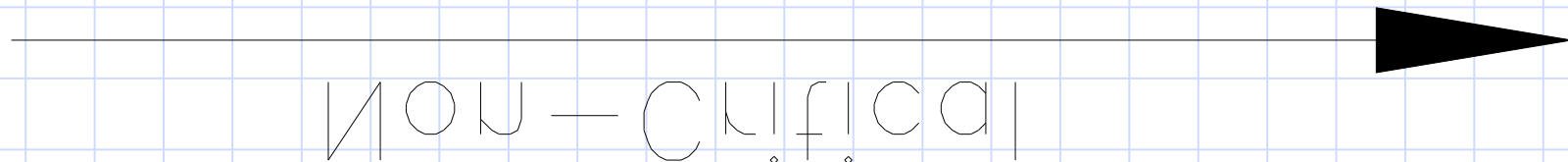
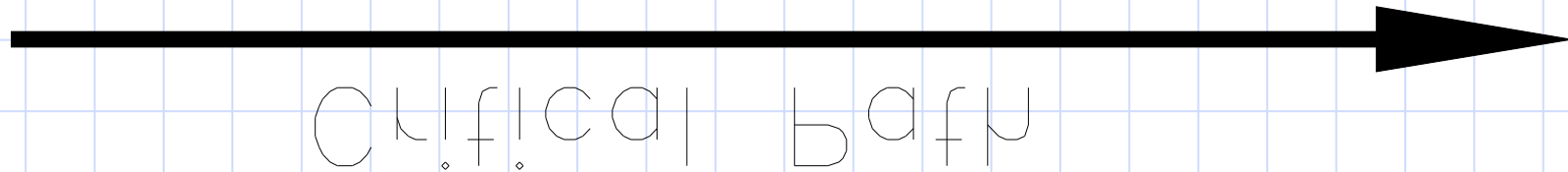
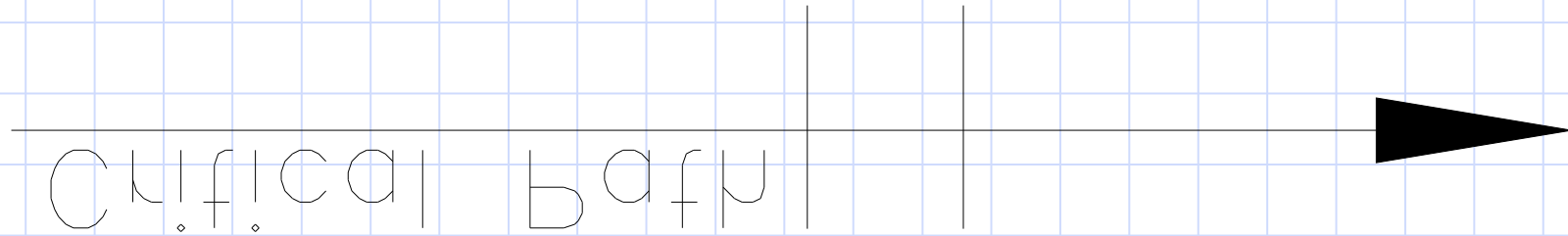
After the activity relationships are identified, they are applied to a logic diagram. The standard format for a logic diagram is the "Activity-on-the-Node". The four basic elements are :

- **Activity Nodes.**
- **Start Nodes.**
- **Finish Nodes.**
- **Precedence Arrows.**

ACTIVITY NODE



PRECEDENCE ARROWS



START AND FINISH NODES



LOGIC DIAGRAMS

- ➔ Shown as a Critical Path Method (CPM) logic diagram.
- ▢ Shows accurate, timely, and easily understood picture of the whole project.
- ▢ Easier to plan, schedule, and manage the sequence of required work activities.
- ▢ Graphically shows the interrelationship of each work activity as they relate to the completion of the whole project.

PRACTICAL EXERCISE

PG V-30

60 MINUTES

CPM DIAGRAM LOGIC RULES

- ➔ Which activities start at the beginning of the project? (**Starting**)
- Which activities must be finished before the start of another? (**Preceding**)
- Which activities can start or finish at the same time as another? (**Concurring**)
- Which activities cannot begin until another is finished? (**Succeeding**)

ACTIVITY ESTIMATES

- Estimating each activities required resources and duration times.
- Estimated resources are:
 - Materials.
 - Personnel.
 - Equipment.
 - Man-hours.
 - Equipment-hours.

MATERIAL ESTIMATES

- Work Items.
- Materials.
- Quantities.
- Waste Factors.
- Total Material Requirements.
- Bills of Materials.

EQUIPMENT/PERSONNEL ESTIMATES

- Work Items. **(Activities)**
- Material Quantities. **(Units of work)**
- Work Rate. **(Man-hour Tables)**
- Standard Work Effort (Labor). **(Quantity x Work Rate)**
- Efficiency Factor. **Represented as a Percentage)**
- Troop Effort (Total Labor Hours). **(Standard Effort / Efficiency)**
- Duration (Hours, Days, Weeks, or Months). **(Troop Effort / Crew Size)**

EARLY/LATE EVENT TIMES

- After all duration's have been computed, you are now able to calculate each activities Early and Late event times. (**Forward Pass** and **Backward Pass**)
- Early Start (ES): The earliest time a activity can logically start.
 - Early Finish (EF): The earliest an activity can finish without delaying **follow on** activities. (**ES + Duration**)
 - Late Finish (LF): The latest an activity can finish without delaying the **entire** project.
 - Late Start (LS): The latest time an activity can start without delaying the entire project. (**LF - Duration**)

ACTIVITY LIST WITH ESTIMATED DURATION'S

<u>Activity Number</u>	<u>Activity</u>	<u>IPB</u>	<u>Duration</u>
5	"Topo" project site	None	2 days
10	Create project drawings	5	2 days
15	Order gravel	None	6 days
20	Prefabricate forms	None	1 day
25	Clear roadway	10	2 days
30	Set road alignments	25	1 day
35	Establish road grades	30	1 day
40	Check road grades	35	2 days
45	Lay gravel	15,40	2 days
50	Clear pad site	10	1 day
55	Layout pad batterboards	50	1 day
60	Excavate pad footings	55	2 days
65	Check pad elevations	60	1 day
70	Place concrete forms	20,65	1 day
75	Pour concrete	70	1 day
80	Cure concrete	75	6 days
85	Remove forms	80	1 day
90	Perform "As-built"	45,85	2 days

CRITICAL PATH & CRITICAL ACTIVITIES

- After completing the event times, you can determine the "critical path" of the project and all of the "critical activities" by simple observation using the following guidelines:
 - The ES for an activity is the same as its LS.
 - The EF for an activity is the same as its LF.

EARLY/LATE EVENT TIMES DEMONSTRATION

◆ PG V-31

PRACTICAL EXERCISES

PG V-32 & V-33

60 MINUTES

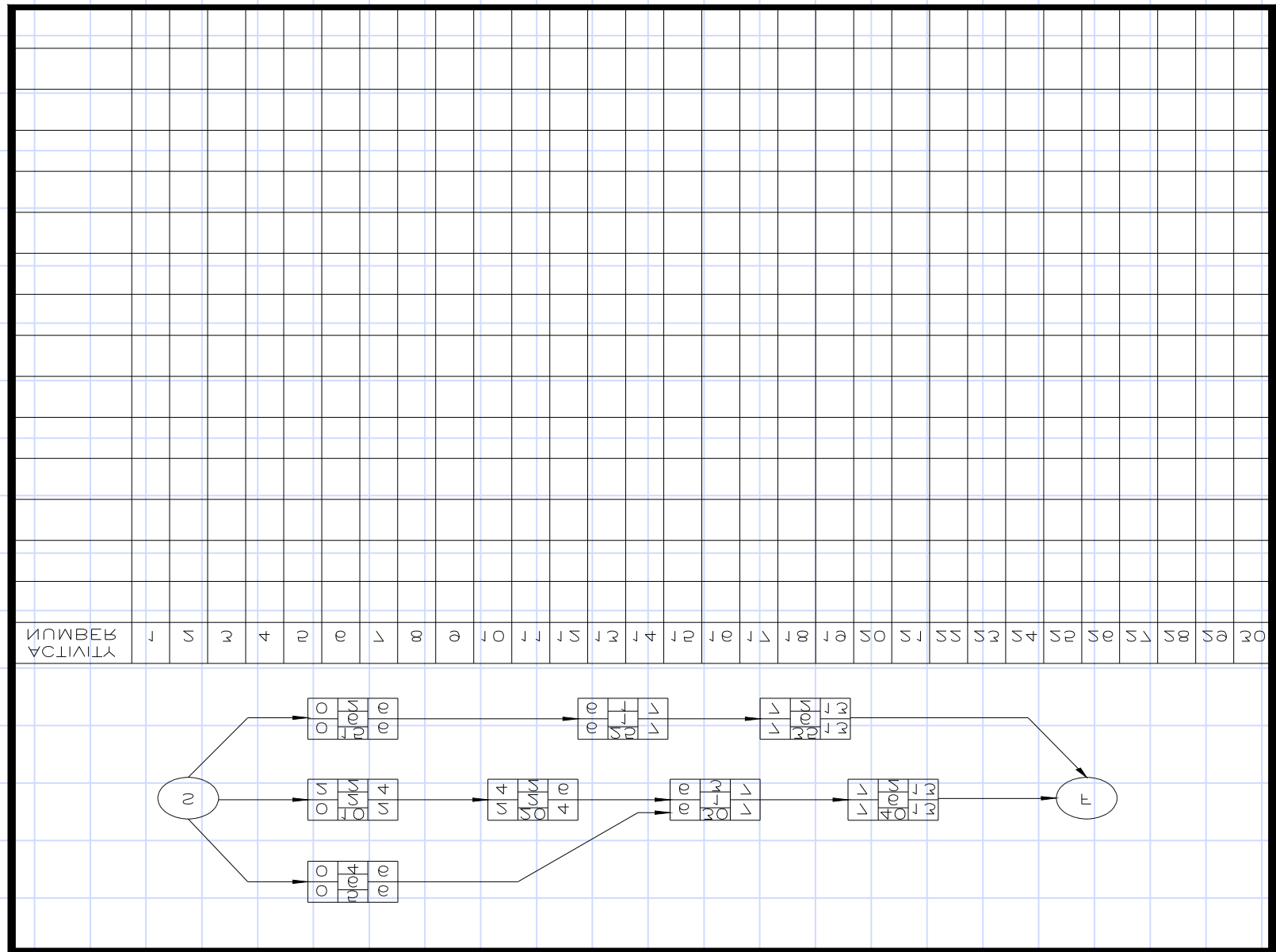
EARLY START SCHEDULES

- An early start schedule, when joined with the logic diagram, graphically shows all of the planning information that is needed to manage the construction project from start to finish.
- Any activity not on the "Critical Path" will contain some float. Float is any extra time that is available to complete an activity beyond its actual duration, without effecting the entire project.

EARLY START SCHEDULE DEMONSTRATION

◆ PG V-34

EARLY START SCHEDULE FORM



FLOAT

- ➔ Total Float (TF): The entire amount of time that an activity can be delayed without delaying the entire project completion time. **$TF = LS - ES$ or $LF - EF$.**
- Interfering Float (IF): Time that is available to delay an activity without delaying the projects entire completion time, but may delay the start of one or more non-critical activities. **$IF = LF - ES$ of following activity. (Use the smallest ES time)**
- Free Float (FF): Time that is available to delay an activity without delaying the start of any other

FLOAT

_ALL FINISHING ACTIVITIES WILL CONTAIN
ONLY FREE FLOAT

NO CALCULATIONS NEEDED

□ Free Float (FF): Time that is available to delay an activity without delaying the start of any other activity, or the entire projects completion time.

RESOURCE ABBREVIATIONS

→ **SQUAD = SQ 5-TON = 5T TRAM = TR**

→ **SCRAPER = SC DOZER = DZ GRADER = GD**

▮ **SEE TRAC = ST EXCAVATOR = EX**

▮ **COMPACTOR = CP SHEEPS FOOT = SF**

▮ **SURVEY CREW = S HUMMER = HV**

▮ **DRAFTSMAN = D**